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FACTORS IN TRANSPORTATION OF STRAWBERRIES FROM THE OZARK REGION

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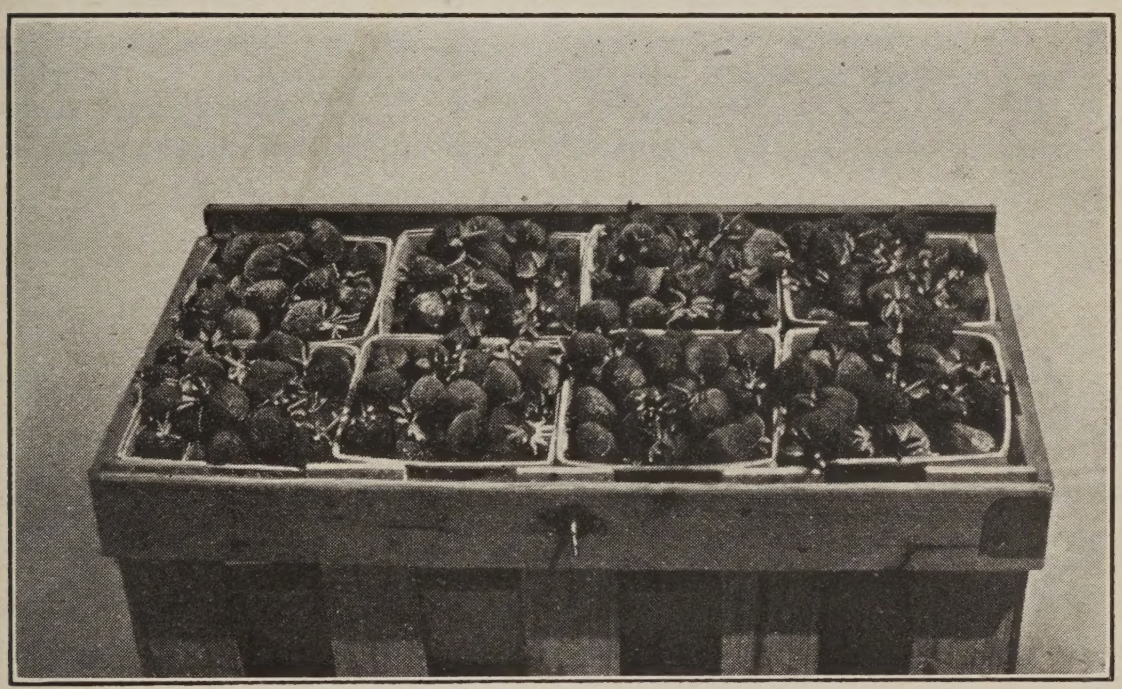

UNITED STATES DEPARTMENT OF AGRICULTURE
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CONTENTS.

GENERAL CONSIDERATIONS.

THE annual value of the strawberry crop in the United States is nearly $18,000,000.00 according to figures compiled by the United States Department of Agriculture. There is probably no other fruit crop shipped in the fresh state to anything like the same extent, which is so extremely perishable. It is universally recognized as a crop which must be handled with the greatest care to avoid loss.

The three fundamental requirements for successful shipping of strawberries are: (1) Careful handling to prevent bruising and mechanical injuries, (2) quickness of cooling after harvesting, and (3) efficient refrigeration in transit. In order to reduce the loss from decay in transit the present methods, both of handling and of refrigeration, must be improved. The chief strawberry decay is one which develops very rapidly under favorable temperatures. The fungus which causes the decay gains entrance through injured parts of the berry. Poorly handled berries shipped under good refrigeration will soon develop decay after being removed from the iced car in which they are shipped, yet it is very desirable that strawberries be maintained in a sound condition for a considerable period after removal from the cars. Small fruit dealers, for the most part, are not able to keep the fruit under ice or refrigeration after removal from the car, and in many cases strawberries become almost worthless on their hands in two or three days' time.

Although great improvement may be effected in preparing the fruit for shipment, it is impossible under commercial conditions to eliminate all injuries. After picking, injuries occur in packing crates, in loading the packages into cars, and from jarring in transit. After every possible care has been exercised in preparing strawberries for shipment, refrigeration must be relied upon to prevent decay in transit.

During the season of 1917, the United States Department of Agriculture made studies of the problems involved in transporting strawberries to market from Northwestern Arkansas and Southwestern Missouri. Although the studies were limited to the strawberries grown in the Ozark region, the results obtained are applicable to all strawberry-producing regions. The work here reported was made possible through the assistance and cooperation of the railroad lines operating in that territory, and the leading strawberry shipping organizations. The results obtained confirmed those of previous seasons and clearly show the need of improvement in present handling and transportation practices. One car which had been kept well iced during the three days it was in transit, when inspected at the market, showed an average of twenty per cent decay in the top layer crates of the entire load. Other cars showed nearly as heavy decay, and receivers stated that heavier decay was common. The amount of loss in berries from these cars must have increased very considerably before they reached the consumers, as after removal from the iced cars the growth of decay is rapid in berries picked and packed according to ordinary commercial practices.

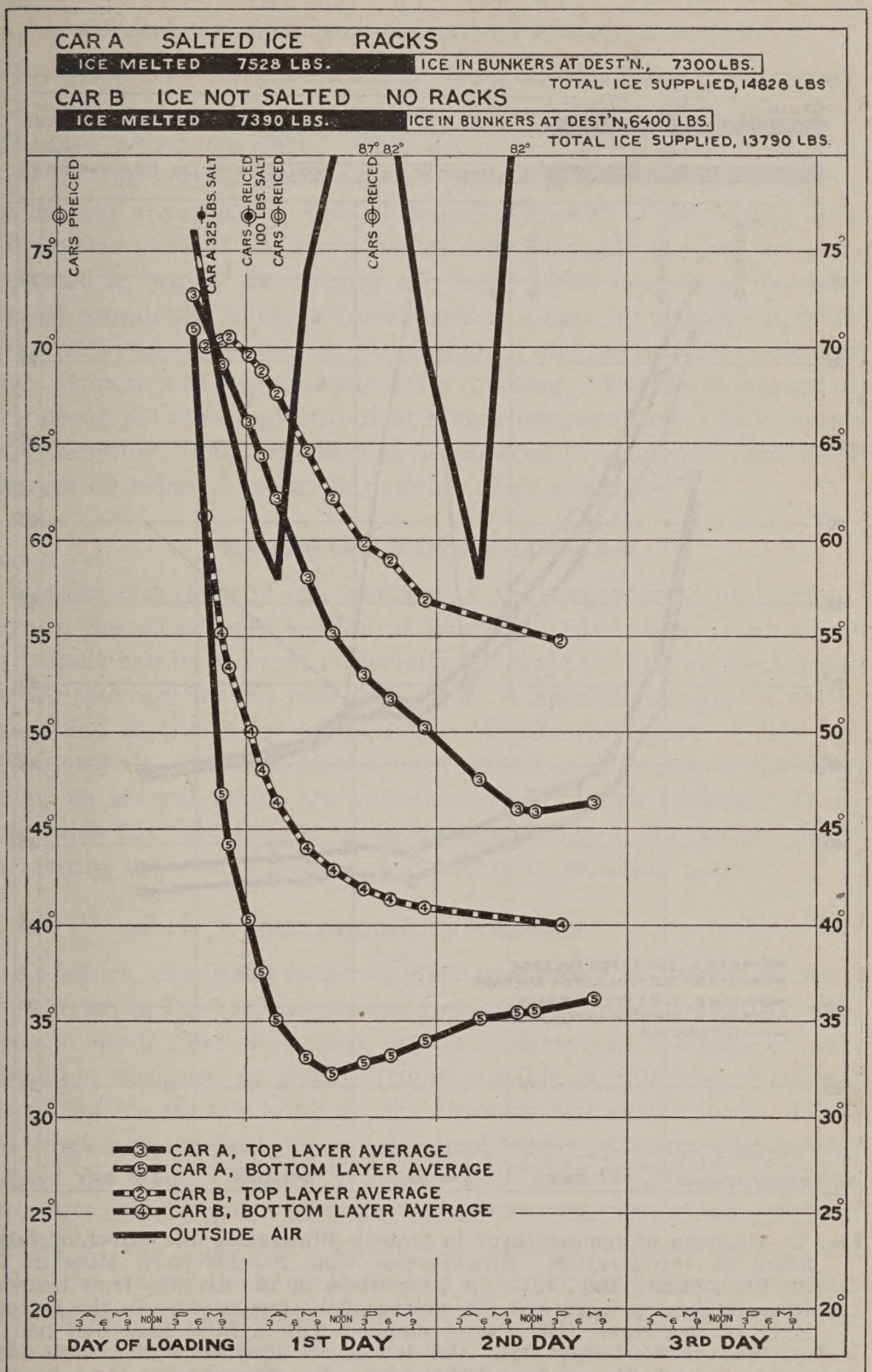

Fig. 1.—Diagram illustrating the effect of salted ice on temperatures of strawberries in transit from Southwestern Missouri to St. Paul, Minn., May, 1917. Average fruit temperatures in the top and the bottom layers of two cars. Car A, salted, racks, insulated bulkheads. Car B, not salted, no racks, solid bulkheads.

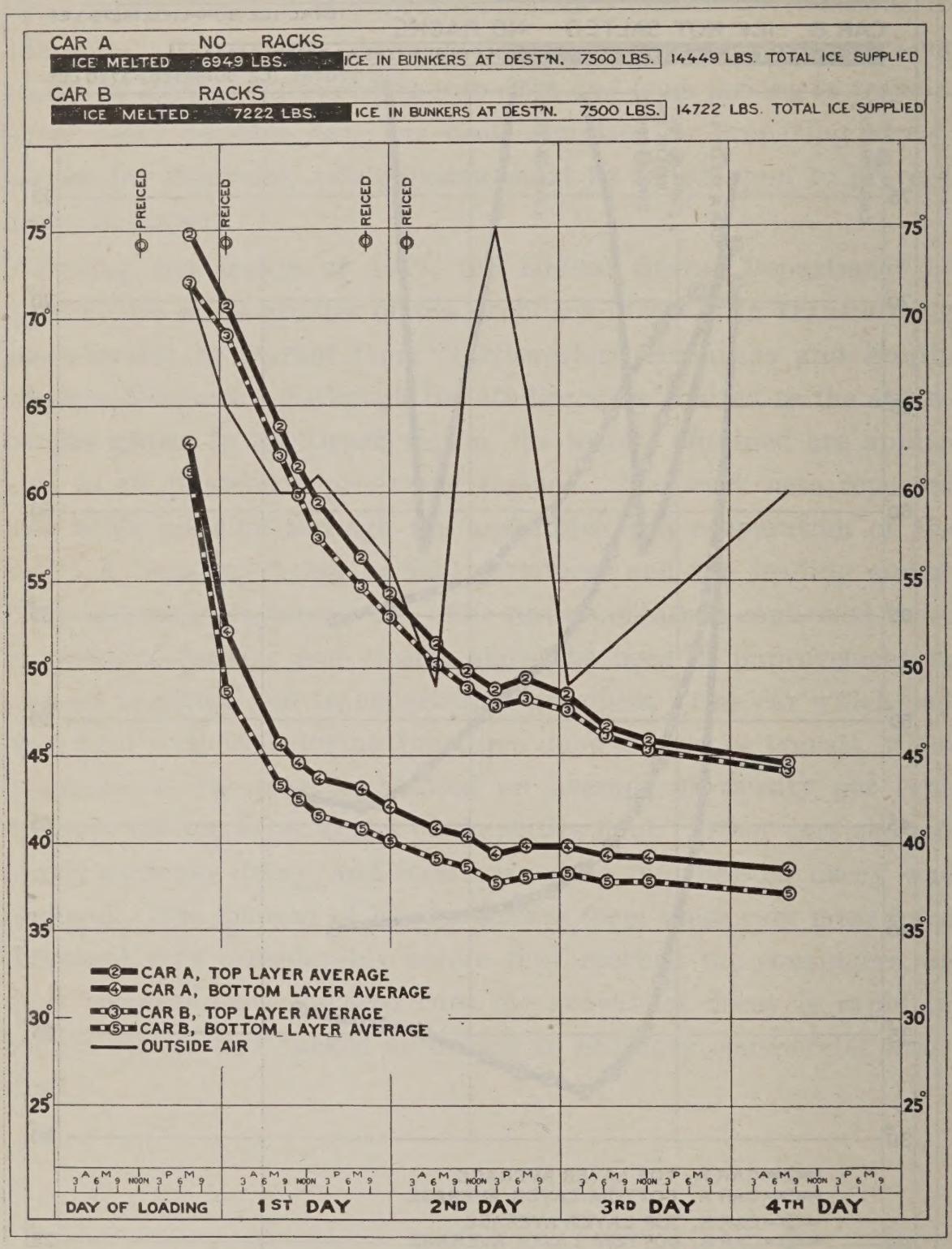

Fig. 2.—Diagram of temperatures in transit, illustrating the effect of false floors on refrigeration. Strawberries from Southwestern Missouri to St. Paul, Minn., May, 1917. A comparison of the average fruit temperature in the top layer and the average fruit temperature in the bottom layer of two cars. Car A was supplied with a false floor and had a splashboard two inches high. Car B was not supplied with a false floor and had a splashboard four inches high. In other respects the two cars were constructed alike and they were both loaded with the same quantity of fruit.

PROMPT COOLING NECESSARY TO PREVENT DECAY.

Investigations have shown that most of the losses from decay of strawberries in transit have been caused by a fungus organism, *Rhizopus nigricans* Ehrb.[1] This decay is characterized by a collapse of the berries and a loss of juice which stains the boxes in which they are packed. The white aerial growth of the fungus may not appear at least for a number of days, depending upon the temperature at which the berries are held. This decay can be held almost completely in check for a week or longer by temperatures no lower than 46 to 50 degrees Fahrenheit if the berries are cooled to that temperature immediately after picking. The development of this decay is exceedingly rapid at higher temperatures. It is essential, therefore, that strawberries be reduced to a temperature of 50 degrees or below as soon as possible after picking.

PRECOOLING BEFORE LOADING.

Results obtained by the workers of the Department of Agriculture in the strawberry section of Louisiana have shown that decay in transit can be reduced materially by rapid cooling of the berries before they are loaded into iced cars. A specially insulated storeroom and facilities for supplying a forced circulation of cold air are required. One objection to this system is the delay to the shipment, as several hours are consumed in thorough cooling. Train schedules for fast freight often are such that a few hours' delay in loading a car may mean a day's delay in reaching market.

PRECOOLING IN TRANSIT.

An effort was made to accomplish precooling in transit by salting the ice in the bunkers immediately after loading. For this purpose a special car was used, which had certain features of construction designed to permit freest possible circulation of the air from the ice in the bunkers out through the entire load. These features were: a false floor, solid insulated bulkheads, and a wire basket ice cage. Figure 1 shows that more rapid cooling was obtained in such a car with the use of salt than in an ordinary car loaded at the same time which was handled without salting the ice. The ice should be well worked down in the bunker when salt is to be used. Coarse salt number two or larger is preferred. The salt should not be applied until after the car is loaded, but should be applied as soon afterwards as practicable. It should be worked into the ice with an ice pick or similar tool. The bulk of the salt

[1]See United States Department of Agriculture Bulletin 531, Rhizopus Rot of Strawberries in Transit, by Neil E. Stevens and R. B. Wilcox. 1917.

to be used should be put in at the first application, and near the top of the ice. A smaller quantity may be applied twelve hours or more later when the car is being re-iced.

The total quantity of salt recommended for use with strawberries is not to exceed three and one half per cent of the ice capacity of the car bunkers, and less than that if the temperature of the fruit is below 60° F. The use of salt is not recommended for cars not supplied with false floors and solid bulkheads.

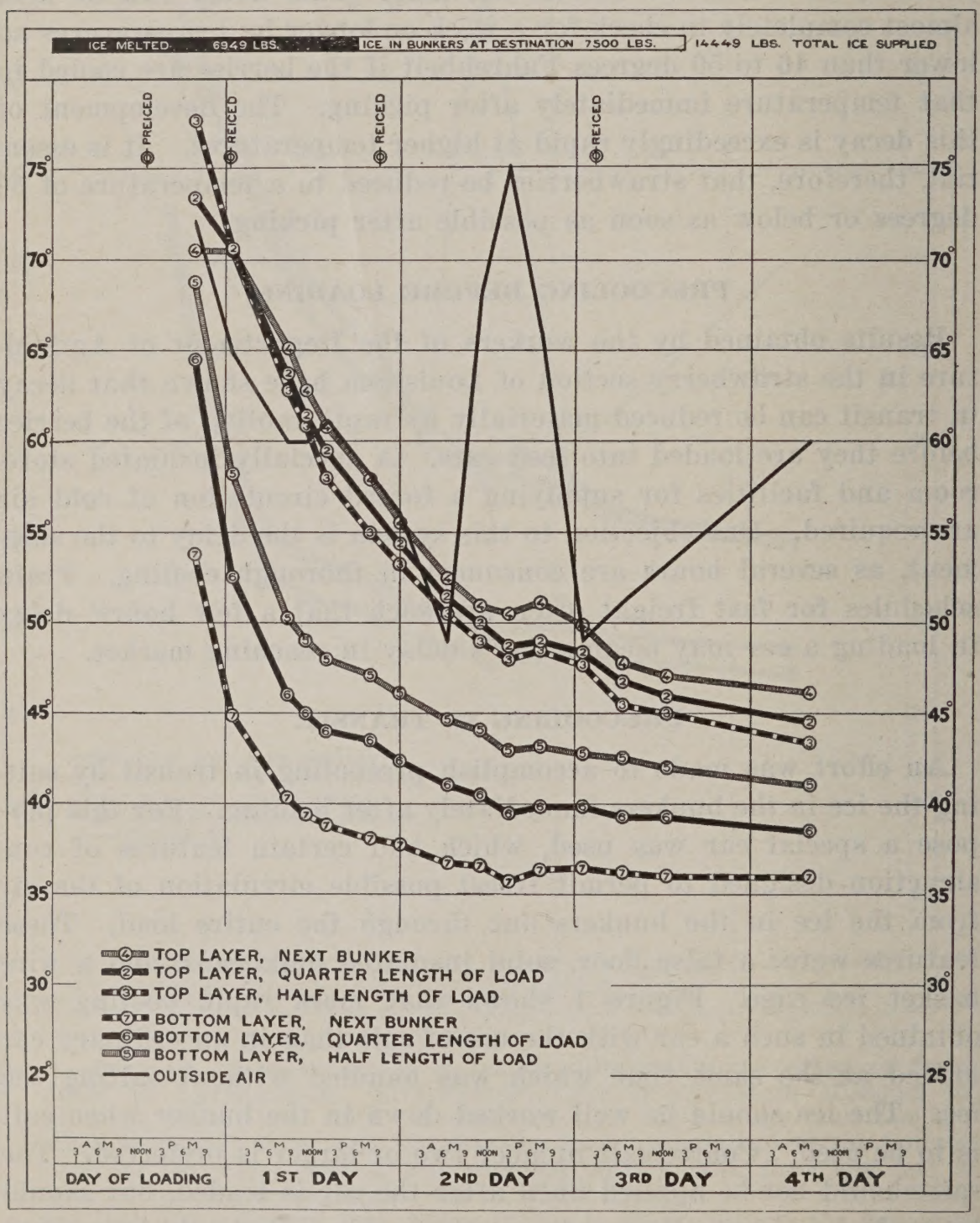

Fig. 3.—Diagram of temperatures in transit, illustrating the distribution of refrigeration in a car of strawberries, shipped from Southwestern Missouri to St. Paul, Minn., May, 1917. This chart shows the fruit temperatures in six different parts of the same car. The car was constructed with solid bulkheads and did not contain a false floor. The ice was not salted.

FALSE FLOORS AID REFRIGERATION.

The false floor used was made by running stringers four inches high lengthwise of the car and nailing strips measuring one by four inches on top of them crosswise of the car, spacing these strips 1½ inches apart. This sort of a false floor permits free circulation of the cold air from the bunkers to the center of the car under the load. The splashboard at the bunker should not be so high that it

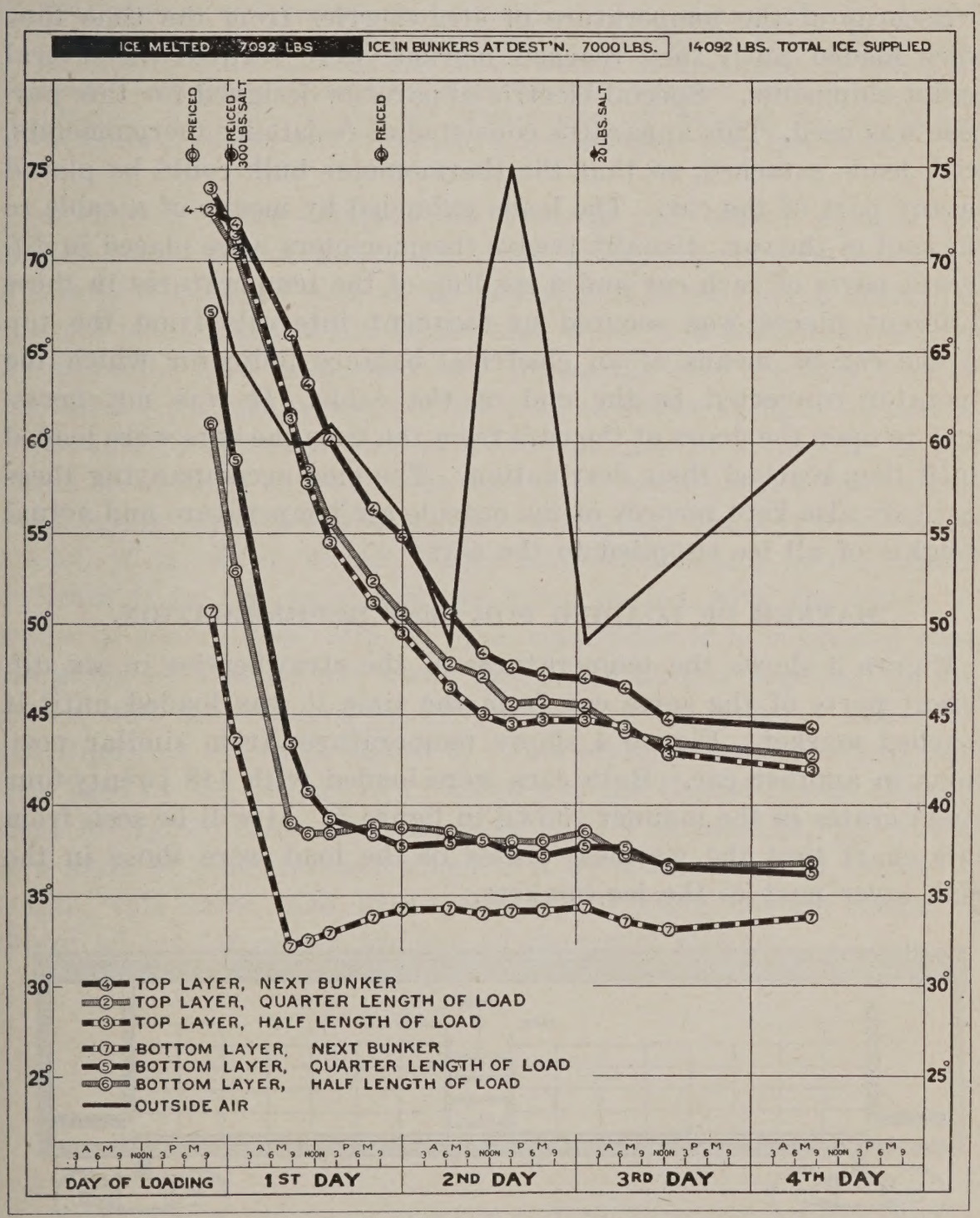

Fig. 4.—Diagram illustrating the distribution of refrigeration in a car of strawberries, shipped from Southwestern Missouri to St. Paul, Minn., May, 1917. This chart shows the fruit temperatures in six different parts of the same car. This car was constructed with solid bulkheads and a false floor. The ice was salted as shown by figures in upper part of chart.

will obstruct this air passage. The benefit to refrigeration from the use of a false floor is shown in figure 2. The two cars used on this test were constructed alike except for the splashboard, which was two inches high in the car in which the false floor was used and four inches high in the other car. Both cars had been in service for the same length of time.

TEMPERATURES IN TRANSIT.

Records of the temperature of strawberries from the time they were loaded until they reached market, were secured on several carlot shipments. Special electric apparatus designed for this purpose was used. This apparatus consisted of resistance thermometers, with leads attached, so that the thermometer bulb could be placed in any part of the car. The leads extended by means of a cable to the roof of the car. Usually twelve thermometers were placed in different parts of each car and a reading of the temperatures in these different places was secured at frequent intervals from the top of the car by means of an electrical balance indicator which the operator connected to the end of the cable. It was not necessary to open the doors of the cars from the time the cars were loaded until they reached their destination. The men accompanying these test cars also kept records of the outside air temperature and actual weights of all ice supplied to the cars.

MANNER OF LOADING FOR BEST REFRIGERATION.

Figure 3 shows the temperatures of the strawberries in six different parts of the same car from the time it was loaded until it reached market. Figure 4 shows temperatures from similar positions in another car. Both cars were loaded with 448 twenty-four quart crates in the manner shown in figure 5. It will be seen from this chart that the warmest crates in the load were those in the fifth layer next to the ice bunkers.

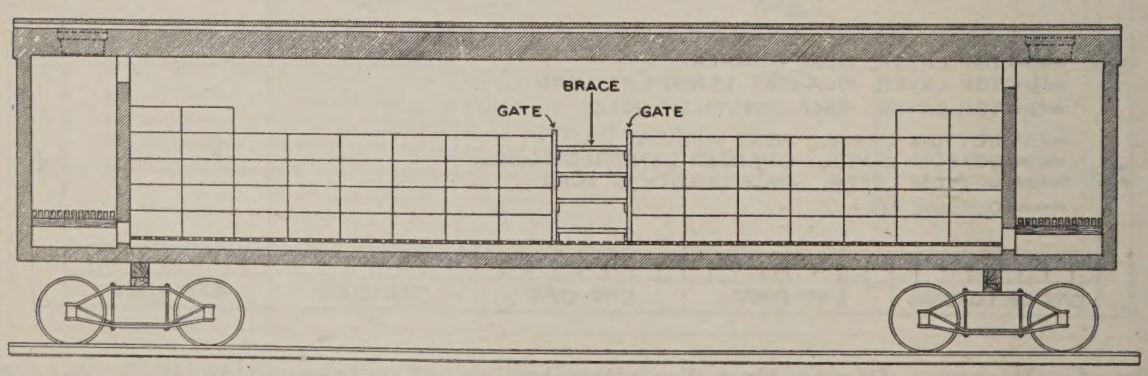

Fig. 5.—Diagram of a strawberry load with center bracing. A longitudinal section of a refrigerator car loaded with twenty-four quart strawberry crates, showing usual method of center bracing. The crates are loaded seven rows across car, and the inside length of car is 33 feet.

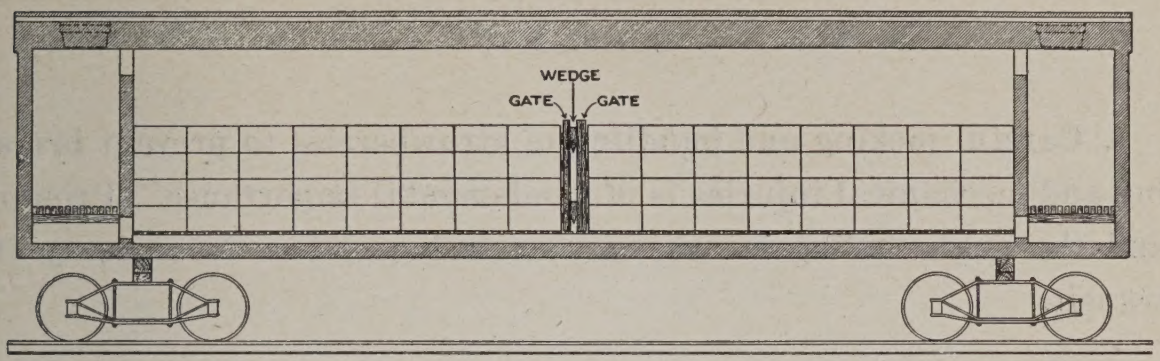

Fig. 6.—Diagram of a strawberry load with the load tightened with wedges. A longitudinal section of a refrigerator car loaded with twenty-four quart strawberry crates showing the use of wedges between gates in center of load. Less space is required than for the ordinary method of center bracing. This car contains the same number of crates as the one shown in figure 1, and no part of the car is loaded higher than four layers.

In view of these temperature records and others secured in similar loads, and of the decay found to be occurring in this part of a large number of cars at the markets, it is considered desirable to avoid loading crates five layers high when it is possible to obtain the minimum load in another way, unless the cars are very heavily insulated. An arrangement of the load as shown in figure 6, makes it possible to obtain a load of 17,000 pounds in a car the inside length of which is 33 feet. The load is 16 stacks long, 7 rows wide, and 4 layers high, and contains 448 twenty-four quart crates. Such a load, 16 stacks in length, leaves insufficient space in the center to brace it in the usual manner when loaded with the kinds of crates in general use. Under these conditions it is suggested that the gates be blocked out until they come almost together in the center, and that wedges be driven in between them to make the load tight, as shown in figure 6. This style of center bracing has been used by the Bureau of Chemistry of the United States Department of Agriculture, with excellent results in loading egg crates. If a style of crate is used which is a little less than 24 inches in length, this same load arrangement will leave enough space in center of car for center bracing in the usual manner.

SUMMARY.

1. Careful picking and handling of strawberries to prevent bruising and mechanical injuries is of fundamental importance. Prompt and thorough cooling is necessary to reduce losses from decay in transit.

2. The use of salt immediately after loading and again at the first re-icing, about twelve hours later, is desirable in order to hasten the rate of cooling when cars can be had which are equipped with false floors, basket bunkers, and solid insulated bulkheads. About two and one half per cent of the ice capacity of the bunkers at the first application and one per cent at the second is advised unless the temperature of the fruit when loaded is lower than 60° F. in which case less salt should be used.

3. Loading crates higher than four layers in the car is to be avoided as far as possible in cars of standard length. Extra space in the center of the car can be eliminated by bracing with wedges instead of using long bracing strips.